PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicant:	Leroy M. Edwards et al.
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Examiner:	Keith D. Walker
Title:	PASSIVE HYDROGEN VENT FOR A FUEL CELL
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Commissioner for Patents
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Reply Brief Under 37 C.F.R. § 41.41

Sir:

This is a response to the Examiner's Answer dated September 29, 2010, in which all of the former rejections were withdrawn and two new rejections were imposed.

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Real Party in Interest

The real party in interest in the present application is GM Global Technology Operations, Inc.; an assignment to GM Global Technology Operations, Inc. was recorded with the U.S. Patent and Trademark Office on January 13, 2009 at reel 022092, frame 0737. Previously, the inventors assigned the application to General Motors Corporation, an assignment that was recorded by the USPTO February 5, 2004 at reel 014963, frame 0881.

Related Appeals and Interferences

There are no other appeals, interferences, or judicial proceedings that will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of the Claims

Claims 1-5, 7, 9, 11-13, 15, 18, and 20 are pending in this Application and stand finally rejected. Claims 6, 8, 14, 16, and 19 are cancelled. This appeal is taken as to all of the rejected claims, claims 1-5, 7, 9, 11-13, 15, 18, and 20.

Status of Amendments

No amendment was filed after the final Office Action.

Summary of Claimed Subject Matter

Claims 1 and 11 are independent claims. Claims 2-5 and 7-10 are dependent on claim 1 or ultimately dependent on claim 1 through intermediate claims. Claims 12, 13, 15, 17, 18, and 20 are dependent or ultimately dependent on claim 11.

Independent claim 1

Independent claim 1 claims a fuel cell **60** (page 2, lines 1-6; Fig. 2) comprising a hydrogen flow path (from source **48** along flow line **112** in Fig. 2 (or **44** in Fig. 1) to fuel cell inlet **94** to outlet **96**) configured to pass hydrogen into communication with an anode catalyst of an MEA **8, 10** (page 2, lines 4-5; page 3, lines 19-20; page 6, lines 7-9 & 11-13; Figs. 1 & 2; page 9, lines 1-7 & line 20 to page 10, line 2), a coolant flow path (inlet line or pipe **50** communicating with coolant flow fields of bipolar plates **14, 16** to coolant outlet line **52**; also including bypass line **68**, through line **64**, radiator/fan **66**, coolant reservoir **72** connected by line **70**, pump **74** with line **76** and drain line **84** leading to coolant reservoir **72**) configured to pass coolant through the fuel cell to cool the fuel cell (page 3, lines 20-21; page 6, line 20 to page 8, line 2; Fig. 2), the coolant flow path comprising a coolant reservoir **72** (page 7, lines 5-11; Fig. 2), a first enclosure encompassing at least a part of the coolant flow path, e.g. an element in the coolant flow path, see page 7, line 19-23, or fuel cell stack enclosure **92** (page 8, line 21 to page 9, line 12; Fig. 2), a second enclosure encompassing at least a part of the hydrogen flow path, e.g. fuel cell stack enclosure **92** (page 8, line 21 to page 9, line 12; Fig. 2) or, if fuel cell stack enclosure **92** is the first enclosure, then fuel cell system enclosure **110** (page 9, line 13 to page 10, line 11), a first passive hydrogen vent **88** (page 7, line 19 to page 8, line 2; Fig. 2), or **98** (page 9, lines 9-12, Fig. 2), depending on the identity of the first enclosure and a second

hydrogen vent **98** (page 9, lines 9-12) or **108** (page 10, lines 6-11), depending on the identity of the second enclosure.

The first passive hydrogen vent **88** or **98** is configured to vent hydrogen from the first enclosure without reliance upon any electrical device or other active components to function (page 8, lines 3-14; page 9, lines 9-12) and configured to maintain the hydrogen concentration within the first enclosure below about 4 percent (page 4, lines 7-8; page 8, lines 15-17; page 9, lines 9-12). The second hydrogen vent is configured to vent hydrogen from the second enclosure (page 9, lines 9-12; page 10, lines 6-11).

Independent claim 11

Independent claim 11 provides a method of manufacturing an MEA fuel cell, comprising creating a hydrogen fuel flow path (from source **48** along flow line **112** in Fig. 2 or **44** in Fig. 1 to fuel cell inlet **94** to outlet **96**) to conduct hydrogen through the MEA fuel cell (page 2, lines 4-5; page 3, lines 19-20; page 6, lines 7-9 & 11-13; Fig. 2; page 9, lines 1-7 & line 20 to page 10, line 2), creating a coolant flow path (inlet line or pipe **50** communicating with coolant flow fields of bipolar plates **14, 16** to coolant outlet line **52**; also including bypass line **68**, through line **64**, radiator/fan **66**, coolant reservoir **72** connected by line **70**, pump **74** with line **76** and drain line **84** leading to coolant reservoir **72**) configured to pass coolant through the fuel cell to cool the fuel cell (page 3, lines 20-21; page 6, line 20 to page 8, line 2; Fig. 2), enclosing at least a part of the coolant flow path in a first enclosure (page 7, line 19-23 or fuel cell stack enclosure **92** (page 8, line 21 to page 9, line 12; Fig. 2)), providing a first passive hydrogen vent **88** (page 7, line 19 to page 8, line 2; Fig. 2), or **98** (page 9, lines 9-12, Fig. 2), depending on the identity of the first enclosure in the first enclosure, enclosing at least a part of the hydrogen fuel

flow path in a second enclosure **92** (page 8, line 21 to page 9, line 12; Fig. 2) or, if fuel cell stack enclosure **92** is the first enclosure, then fuel cell system enclosure **110** (page 9, line 13 to page 10, line 11), and providing a second hydrogen vent **98** (page 9, lines 9-12) or **108** (page 10, lines 6-11), depending on the identity of the second enclosure, in the second enclosure.

The coolant flow path comprises a coolant reservoir **72** (page 7, lines 5-11; Fig. 2).

The first passive hydrogen vent is configured to passively maintain the level of hydrogen which leaks into the first enclosure below a concentration level of about 4 percent without reliance upon any electrical device or other active components to function (page 8, lines 3-14; page 4, lines 7-8; page 8, lines 15-17; page 9, lines 9-12).

The second enclosure captures hydrogen that leaks, directly or indirectly, from the hydrogen fuel flow path (page 9, lines 5-12; page 10, lines 6-11).

The second hydrogen vent configured to maintain the level of hydrogen which leaks into the second enclosure below a concentration level of about 4 percent (page 9, lines 10-12; page 10, lines 6-11).

Grounds of Rejection to be Reviewed on Appeal

Claims 1-5, 7, 9, 11-13, 15, 18, and 20 are rejected under 35 U.S.C. 103(a) over Genc, U.S. Patent Application Publication 2002/0160245 in view of Edlund, U.S. Patent Application Publication 2002/0114984, Noda, U.S. Patent 5,623,390, and Breault, U.S. Patent 6,416,892.

Claims 10 and 17 are rejected under 35 U.S.C. 103(a) over Genc, U.S. Patent Application Publication 2002/0160245 in view of Edlund, U.S. Patent Application Publication 2002/0114984, Noda, U.S. Patent 5,623,390, Breault, U.S. Patent 6,416,892, and Buzzelli, U.S. Patent 4,168,349.

Arguments

I. Claims 1-5, 7, 9, 11-13, 15, 18, and 20 are patentable over the combination of the Genc, Edlund, Noda, and Breault references because there is no apparent reason to modify the Genc release valve as the Examiner proposed nor to modify Genc to include two enclosures each with passive hydrogen vents, which is not provided by the combined references.

"The Examiner has the initial burden to set forth the basis for any rejection so as to put the patent applicant on notice of the reasons why the applicant is not entitled to a patent on the claim scope that he seeks – the so-called '*prima facie* case.'" *Ex parte Frye*[1]; *In re Piasecki*[2].

The Genc patent teaches venting gas from a cooling system, "mainly air [that] can be drawn into the cooling system from the outside or from a fuel cell cabinet (main enclosure around the fuel cell) due to local negative pressures during normal operation or during a coolant drain process when the system is temporarily shut down." Para. [0004], lines 7-11. The gas causes a problem because it "adversely affects the coolant circulation and the proper functioning of heat exchangers." *Id.,* lines 4-7. Release valve 30, Fig. 1, releases gas at a first pressure. Para. [0006]. Because the Genc system concerns pressure release of "mainly air," and teaches that the release is for the purpose of efficient and proper coolant circulation and heat exchange, there is no reason to modify the Genc system to achieve a particular hydrogen gas concentration in a particular enclosure.

The Genc patent teaches only preventing build up of gases that would adversely affect coolant circulation and heat exchange in the heat exchangers. The Examiner argues that one would modify the Genc system to keep it "safe" by changing the Genc release valve to attain a certain level of hydrogen, an aim not even mentioned by the Genc patent, instead of using the

[1]No. 2009-6013, slip op. at 8 (BPAI Feb. 12, 2010) (citing *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992).

[2]745 F.2d 1468, 1472 (Fed. Cir. 1984) (the initial burden of proof is on the USPTO "to produce the factual basis for its rejection of an application under sections 102 and 103") (quoting *In re Warner*, 379 F.2d 1011, 1016 (CCPA 1967)).

Genc release valve for the purpose Genc teaches, to keep gas pressure ("mainly air") at a level to allow efficient circulation and cooling. As such, the Examiner's statement that Genc keeps the fuel cell system "safe" with its release valve is unsupported by the evidence.

The Genc patent does not teach configuring its release valve to vent hydrogen from an enclosure encompassing a part of a coolant flow path including a coolant reservoir. In fact, the Genc cooling system only includes a cooling loop/conduit 22, heat exchanger 24, and pump 26; it contemplates no coolant reservoir. Nor does the Genc patent teach a second enclosure encompassing part of a hydrogen flow path with another vent.

The Examiner relies on the Noda patent for a reason to modify Genc's coolant system, but Appellants believe this reliance is misplaced. The Noda patent provides a solution to the problem of a battery exploding within a computer case. Abstract, last two lines. What happens during a battery explosion is that the hydrogen gas "is discharged from the battery through vent holes 46 and 47 of the cover case 23a into the body case 2 through the communication holes 50, 51 of the body inside cover 48." Col. 9, ll. 7-12, Figs. 1 (case 2) & 11. Routing the gas into the whole volume of case 2 instead of "staying within the cover 48 [prevents] the hydrogen gas concentration in the cover 48 from reaching an explosive concentration of 4 vol. %. Further, the hydrogen gas which has entered the body case 2 is discharged to the exterior through the vent holes 44 and through holes 45 for voice to prevent the hydrogen gas concentration in the body case 2 from reaching the explosive concentration of 4 vol. %." Col. 9, ll. 12-23; fig. 3. The film over vent hole 44 is waterproof—a barrier to liquid water. See Abstract, line 13.

Noda, then, is concerned with accommodating a sudden, explosive release of hydrogen, by passing it into the whole computer case volume and then venting the gas through a waterproof film. This has nothing to do with any passive vent to, as in Appellants' claims, "**maintain**"

hydrogen concentration in certain areas of an operating fuel cell at below about 4%. Unlike Noda's exploding battery, the fuel cell does not generate hydrogen in a sudden, single-event, catastrophic explosion.

The Noda patent does not relate its battery explosion to fuel cells or to the problem of accumulation of hydrogen in a coolant system. Nor does the Noda patent provide any guidance regarding configuring vents and enclosures within fuel cell systems.

The Examiner says that the Noda computer battery is "associated with hydrogen" and "[h]ydrogen gas can be expelled by the battery" and "build up . . .within the enclosure" to become unsafe. This is an imprecise and somewhat misleading characterization of Noda. The Noda patent is concerned with venting hydrogen from a battery explosion. Abstract, last two lines. The Noda computer is not "associated with hydrogen" in the same way a fuel cell is associated with hydrogen. The concern Noda has with explosive release of battery hydrogen is unlike Genc's concern with gas bubbles blocking coolant flow. Nor does the Noda patent advance the knowledge of control of hydrogen accumulation in fuel cell cooling systems. The Noda patent is not in the field of fuel cells, and the Noda patent does not concern the problem Appellants faced of migration of hydrogen from the flow field into the cooling system. Therefore, the Noda patent is not analogous art to the present invention and cannot support an obviousness rejection. *In re Clay.*[3]

In sum, there is no reason for the skilled artisan to turn to the Noda patent in the first place to solve a fuel cell problem. Nor is there a clear way in which one would "modify the vent and both enclosures of Genc" as urged by the Examiner. The Genc vent is for the purpose of venting gas that is "mainly air" drawn into a cooling system from the outside or from a main

[3] 966 F.2d 656 (Fed. Cir. 1992).

enclosure to avoid reducing coolant flow. The Genc patent is not trying to keep a concentration of hydrogen gas down to prevent an explosive situation, as the Examiner intimates on page 5 of the Answer. The Genc patent is concerned with accumulated gases blocking coolant circulation. Genc, para. [0004]. Genc does not mention explosive accumulation of any gas. Unlike Genc, the Noda patent deals with what would happen if a battery exploded in a computer case. The only apparent link between these disclosures is Appellants' own specification and Appellants' own invention.

On page 4 of the Answer, the Examiner has urged the Breault patent as evidences that the Genc release valve reduces unwanted gases that "negatively impact" the fuel cell while retaining liquid coolant. With respect, Appellants believe that the Genc patent itself is a more reliable authority on what its own release valve provides. The Genc patent teaches throughout (in at least the Abstract and paragraphs 6-10, 19, 20, 25, 27, 31, and 35) that accumulated gases block coolant circulation and **for that reason** should be removed. The Breault patent, in contrast, appears to be directed to a structure different in kind from the Genc release valve. In the cited passage from column 14, the Breault patent discusses an interdigitated fine pore enthalpy exchange device which appears to not be present in Genc or to be similar to anything in Genc. Breault also mentions a packed bed degasifier **86** for adsorbing gases, col. 13, ll. 33-34, which appears incompatible with the Genc method and configuration. (Perhaps one might replace the Genc release valve with a packed bed degasifier.) Moreover, the Breault reference also does not discuss or appreciate accumulation of hydrogen **gas**. The problem with which Breault concerns itself is dissolved gases that form ionic species and increase undesirable conductivity of the cooling fluid, interfere with the PEM, and may result in gas bubbles interrupting coolant flow.

Column 14, lines 22-37. The passage the Examiner cites from column 3 likewise concerns dissolved gases and never mentions hydrogen accumulation in a fuel cell as an explosion hazard.

As for the claim element of an enclosure encompassing part of a hydrogen flow path with a passive hydrogen vent, the Examiner argues on page 5 of the Answer that one would put the Noda vents into all the enclosures of Genc. The problem with the Examiner's argument is that the Genc enclosures do not contain a nickel-hydrogen battery that may explode and for which explosion Genc must prepare as did the Noda inventors. Not one of the references provides a reason to vent a second enclosure encompassing at least a part of the hydrogen flow path.

The Examiner uses the Edlund publication for supposedly teaching a second enclosure with a second passive hydrogen vent. Edlund teaches housing 140 encompassing a fuel cell system. The housing 140 can be combined with an energy-consuming device 25 that can include a body 142, such as a motor vehicle. Edlund para. [0064]. Edlund does not, however, teach putting a vent in either housing 140 or body 142. The Examiner appears to argue that if there is a body, it is obvious to put a vent in it. This, respectfully, is insufficient deductive reasoning to support an obviousness rejection. The Examiner has provided no reason why these particular elements in Edlund would be vented. Edlund is silent about any vent or any need to vent. The combination of all of the cited documents do not suggest passive hydrogen vents nor two housings, each with a passive hydrogen vent. The Examiner's speculation that Genc could be modified to have two housings, each with a passive hydrogen vent, is pure hindsight analysis.

A straightforward combination of the cited references fails to provide either an enclosure encompassing a coolant reservoir with a passive hydrogen vent or an enclosure encompassing part of a hydrogen flow path with a passive hydrogen vent. In view of the complete lack of appreciation by the fuel cell patents Genc, Edlund, and Breault of any reason to vent hydrogen in

particular from a coolant system, or to keep its concentration below a certain percent and because the Noda computer battery patent is both nonanalogous art and does not illuminate any issue raised in the other three references, the Examiner has not made out a prima facie case of obviousness. Further, because none of the references says anything about venting an enclosure encompassing a fuel cell hydrogen flow path, or gives any reason to do so, this element is likewise absent from the prior art, and the Examiner has not set out a prima facie case of obviousness for this additional reason.

For these reasons, Appellants request that the rejection be REVERSED.

II. Claims 4-5 and 12-15 are separately patentable because the combination of references cited in the rejection do not disclose or make obvious a configuration in which a first enclosure comprises a coolant reservoir and a passive hydrogen vent is located within a wall of the coolant reservoir.

The Examiner states on page 4 that the Genc gas vent is "located in the wall of the coolant reservoir," but this is not supported by any of the passages he has cited. The Genc patent does not mention or illustrate a coolant reservoir. Paragraph [0020] describes release valve **30** as being connected to conduit **22**. Paragraphs [0021]-[0023] describe features of release valve **30**. Paragraph [0031] describes placing the release valve at the highest point or elsewhere in the cooling system, but also does not mention a coolant reservoir or placing a release valve in a coolant reservoir.

The Examiner bears the initial burden of establishing prima facie obviousness "on the totality of the record, by a preponderance of the evidence with due consideration to the persuasiveness of argument." *Ex Parte Frye*.[4] In meeting the burden, the Examiner must show

[4] Appeal 2009-006013, slip op. at 8-9 (BPAI Feb. 26, 2010) (precedential) (quoting *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992) and citing and quoting *In re Piasecki*, 745 F.2d 1468, 1472 (Fed. Cir. 1984) (the initial burden of proof is on the USPTO "to produce the factual basis for its rejection of an application under sections 102 and 103").

where the evidence supports his conclusions. *Id.* In this case, the Examiner has merely added an "oh, by the way"-type parenthetical clause to say that the claim element of a passive hydrogen vent is located within a wall of a coolant reservoir, but has not provided any evidence to support his claim.

Because the reference on which the Examiner relies to show this claim element does not mention or suggest this claim element, each of claims 4, 5, and 12-15 are separately patentable over the combination of references cited in rejection. Thus, Appellants request for this additional reason that the rejection as to claims 4, 5, and 12-15 be REVERSED.

III. Claims 10 and 17 are patentable over the combination of the Genc, Edlund, Pettit, and Buzzelli references because combination with the Buzzelli reference does not remedy the shortcomings of the combination of Genc, Edlund, Noda, and Breault in regard to supporting prima facie obviousness of independent claims 1 and 11.

Appellants rely on the lack of prima facie obviousness of underlying independent claims 1 and 11 as set out in section I. Accordingly, Appellants respectfully request that the Board REVERSE the rejection of claims 10 and 17 for these same reasons.

Conclusion

Appellants, therefore, respectfully request that the Board to reverse the final rejection of the claims on each ground.

Respectfully submitted,

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Claims Appendix
Copy of the Claims Appealed

1. A fuel cell comprising:

a hydrogen flow path configured to pass hydrogen into communication with an anode catalyst of an MEA;

a coolant flow path configured to pass coolant through the fuel cell to cool the fuel cell, the coolant flow path comprising a coolant reservoir;

a first enclosure encompassing at least a part of the coolant flow path;

a first passive hydrogen vent configured to vent hydrogen from the first enclosure without reliance upon any electrical device or other active components to function and configured to maintain the hydrogen concentration within the first enclosure below about 4 percent;

a second enclosure encompassing at least a part of the hydrogen flow path; and

a second hydrogen vent configured to vent hydrogen from the second enclosure.

2. A fuel cell according to Claim 1, wherein the second enclosure surrounds a member selected from the group consisting of a fuel cell stack through which the hydrogen flow path and the coolant flow path pass and a hydrogen supply reservoir of the hydrogen flow path.

3. A fuel cell according to Claim 1, wherein the first passive hydrogen vent and the second hydrogen vent comprise a porous material selected from the group consisting of cellulose, plastic and metal.

4. A fuel cell according to Claim 1, wherein the first enclosure comprises the coolant reservoir and the first passive hydrogen vent is located within a wall of the coolant reservoir.

5. A fuel cell according to Claim 4, wherein the first passive hydrogen vent is further configured to substantially prevent the coolant from passing through the vent.

7. A fuel cell according to Claim 1, wherein the first passive hydrogen vent and the second hydrogen vent are configured to maintain a hydrogen concentration within the enclosure below about 1 percent without reliance upon any electrical device.

9. A fuel cell according to Claim 1, further comprising a third enclosure that encompasses at least one of the first enclosure and the second enclosure, the third enclosure having a third hydrogen vent.

10. A fuel cell according to Claim 1, wherein the first passive hydrogen vent and the second hydrogen vent are further configured to prevent a flame front from passing through the vent.

11. A method of manufacturing an MEA fuel cell, comprising:

creating a hydrogen fuel flow path to conduct hydrogen through the MEA fuel cell;

creating a coolant flow path configured to pass coolant through the fuel cell to cool the fuel cell, the coolant flow path comprising a coolant reservoir;

enclosing at least a part of the coolant flow path in a first enclosure;

providing a first passive hydrogen vent in the first enclosure, the first passive hydrogen vent configured to passively maintain the level of hydrogen which leaks into the first enclosure below a concentration level of about 4 percent without reliance upon any electrical device or other active components to function;

enclosing at least a part of the hydrogen fuel flow path in a second enclosure which captures hydrogen that leaks, directly or indirectly, from the hydrogen fuel flow path; and

providing a second hydrogen vent in the second enclosure, the second hydrogen vent configured to maintain the level of hydrogen which leaks into the second enclosure below a concentration level of about 4 percent.

12. A method of manufacturing a fuel cell according to Claim 11, wherein the first enclosure comprises the coolant reservoir and the first passive hydrogen vent is located within a wall of the coolant reservoir.

13. A method of manufacturing a fuel cell according to Claim 12, wherein the first passive hydrogen vent passively maintains the level of hydrogen by comprising a porous material capable of passing hydrogen therethrough and capable of substantially preventing the coolant from passing therethrough.

15. A method of manufacturing a fuel cell according to Claim 12, wherein passively maintaining the level of hydrogen further comprises passively maintaining the level of hydrogen which leaks into the enclosure below a concentration level of about 1 percent.

17. A method of manufacturing a fuel cell according to Claim 11, wherein passively maintaining the level of hydrogen further comprises selecting a porous material capable of passing hydrogen therethrough and capable of substantially preventing a flame front from passing therethrough.

18. A method of manufacturing a fuel cell according to Claim 17, wherein selecting a porous material further comprises selecting a porous material selected from the group consisting of cellulose, plastic and metal.

20. A method of manufacturing a fuel cell according to Claim 11, further comprising a third enclosure that encompasses at least one of the first enclosure and the second enclosure, the third enclosure having a third hydrogen vent.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.

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